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ORIGINAL RESEARCH ARTICLE

Influence of ZnSe Surface Coatings for Enhancing the Performance of Multicrystalline Silicon Solar Cells

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Abstract

The current research effort focused on enhancing the power conversion performance of silicon solar cells by minimizing the scattering of incident photons on the solar cell surface. This can be achieved through antireflective thin-film coatings. The main purpose of antireflective coatings is to minimize the reflection of incident light radiation. Silicon solar cells with antireflective thin-film coatings exhibit better light transmittance, and hence power conversion efficiency is improved. Metal chalcogenides are materials with a wider energy band gap and possess better electrical and optical properties. This study aims at using zinc selenide (ZnSe), a metal chalcogenide, as an antireflective coating material. ZnSe was synthesized through a room-temperature thermal evaporation technique. Further, coating of ZnSe on the silicon solar cell was done using an electrospraying technique. The optimal solar cell sample (D3) with thickness of 1.32 µm exhibited maximum transmittance of 95.8% in the visible spectrum. The electrical resistivity of the D3 sample under neodymium radiation was noted as 3.43×10^{-5} Ω m, which was lower than other coated samples. The output efficiency of the sample was found to be 19.95%, which was a 4.58% improvement over pristine solar cells. Based on the observations, it is evident that the synthesized ZnSe is a promising coating material for controlling reflection loss and increasing power conversion efficiency.

Keywords Silicon solar cell · thermal evaporation · antireflection coating · electrospraying · photocurrent generation

Introduction

Due to over-exploitation of natural resources and rapid expansion of the global population, energy demand is increasing day by day. The over-utilization of conventional energy sources such as coal, petroleum and natural gas has led to increased emission of CO_2.[1] This occurs mainly due to the incomplete combustion of fossil fuels. The generation of power from a solar energy source will act as an equivalent alternative energy source with zero emission of CO_2.[2] Photovoltaic cells are a semiconductor device with the ability to convert solar energy into electrical energy.[3] Research on solar photovoltaic technology is booming at a fast rate, in order to meet present energy demands.

The crystalline silicon solar cell is a first-generation solar cell, and can be classified into two major types, monocrystalline and polycrystalline silicon solar cells, based on the source of crystalline silicon.[4] Among them, polycrystalline silicon solar cells have been fabricated from multiple sources of silicon, resulting in minimum fabrication cost.[5] Silicon solar panels show a lower cost-to-power output ratio, and

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